FIG. 1

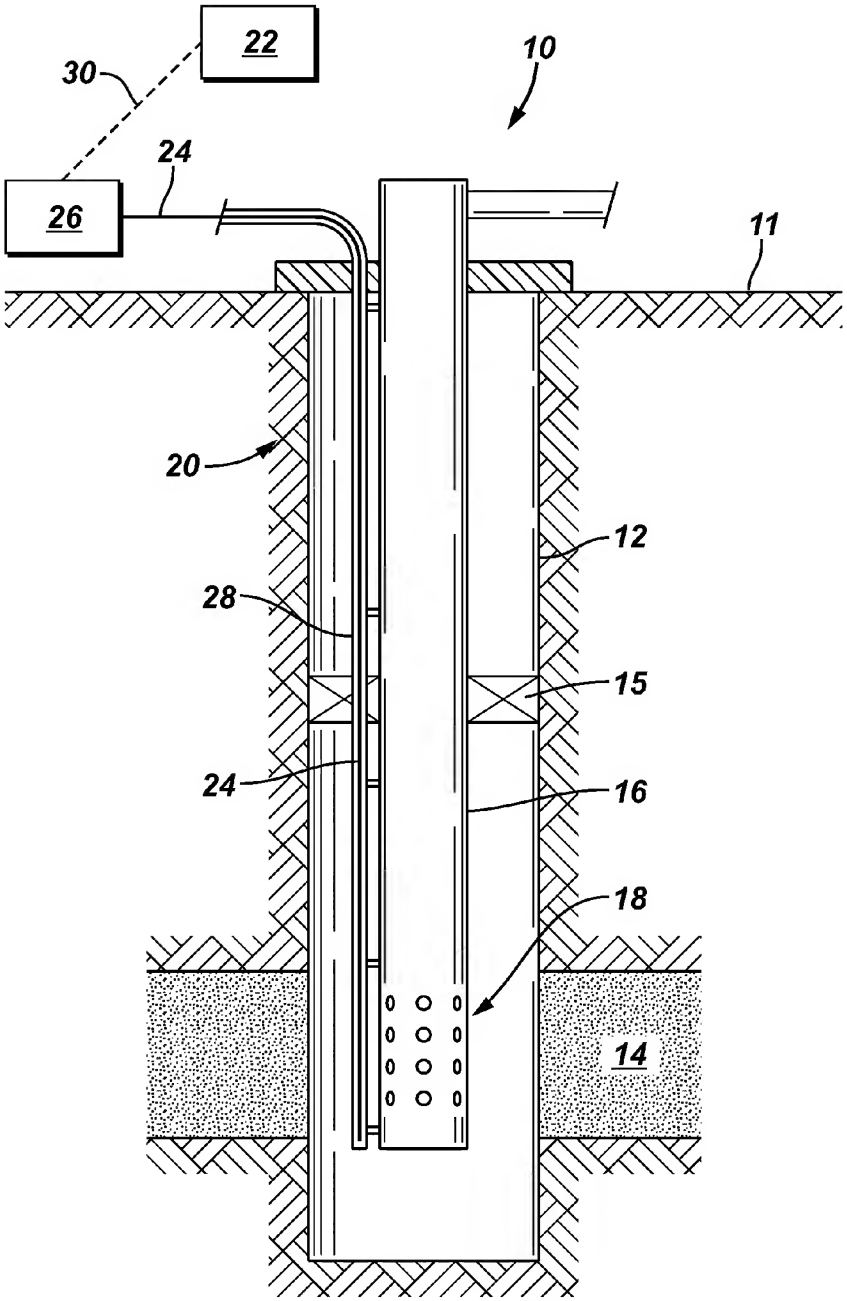

FIG. 2

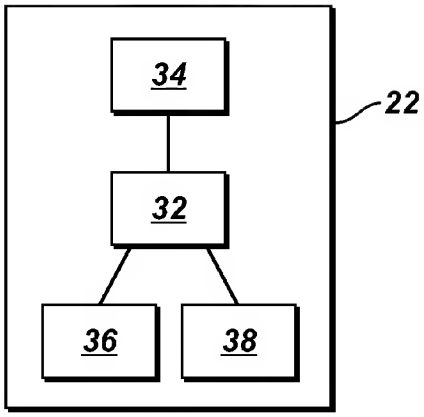

FIG. 3

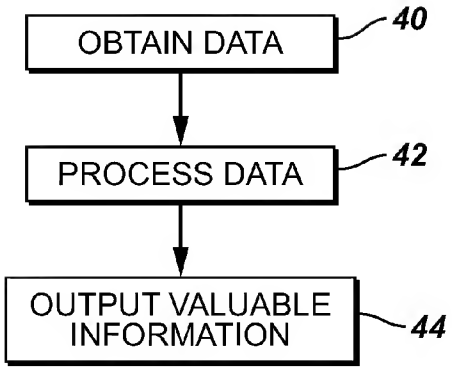

FIG. 5

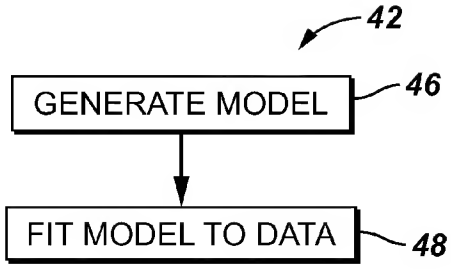

FIG. 4

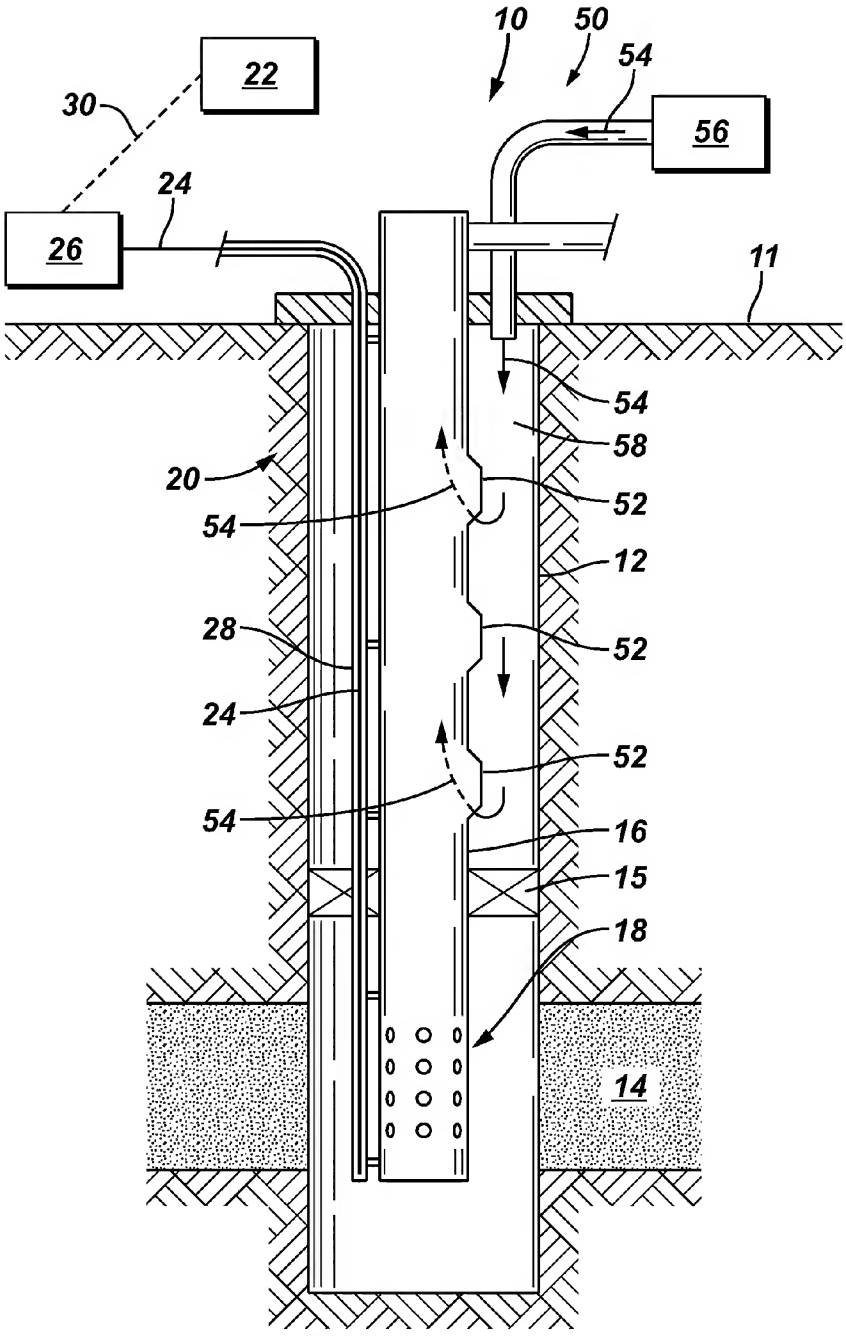

FIG. 6

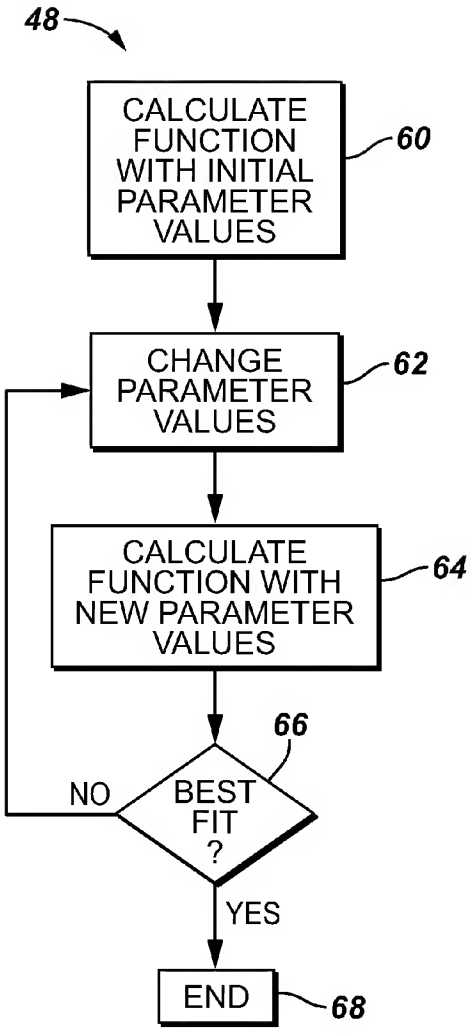
48
CALCULATE FUNCTION WITH INITIAL PARAMETER VALUES
60
CHANGE PARAMETER VALUES
62
CALCULATE FUNCTION WITH NEW PARAMETER VALUES
64
66
BEST FIT ?
NO
YES
END
68

FIG. 7

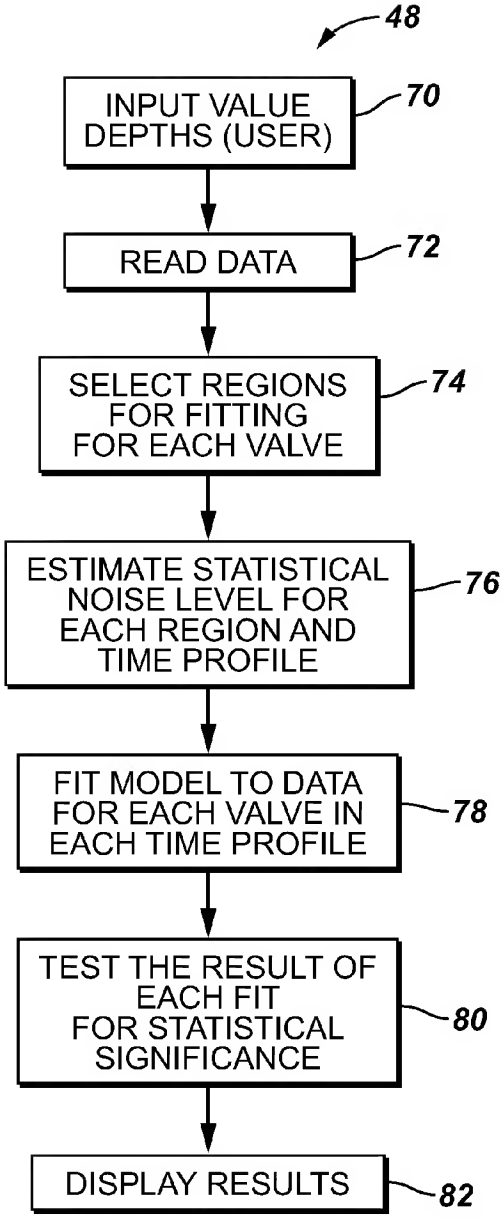
48
INPUT VALUE DEPTHS (USER)
70
READ DATA
72
SELECT REGIONS FOR FITTING FOR EACH VALVE
74
ESTIMATE STATISTICAL NOISE LEVEL FOR EACH REGION AND TIME PROFILE
76
FIT MODEL TO DATA FOR EACH VALVE IN EACH TIME PROFILE
78
TEST THE RESULT OF EACH FIT FOR STATISTICAL SIGNIFICANCE
80
DISPLAY RESULTS
82

FIG. 8

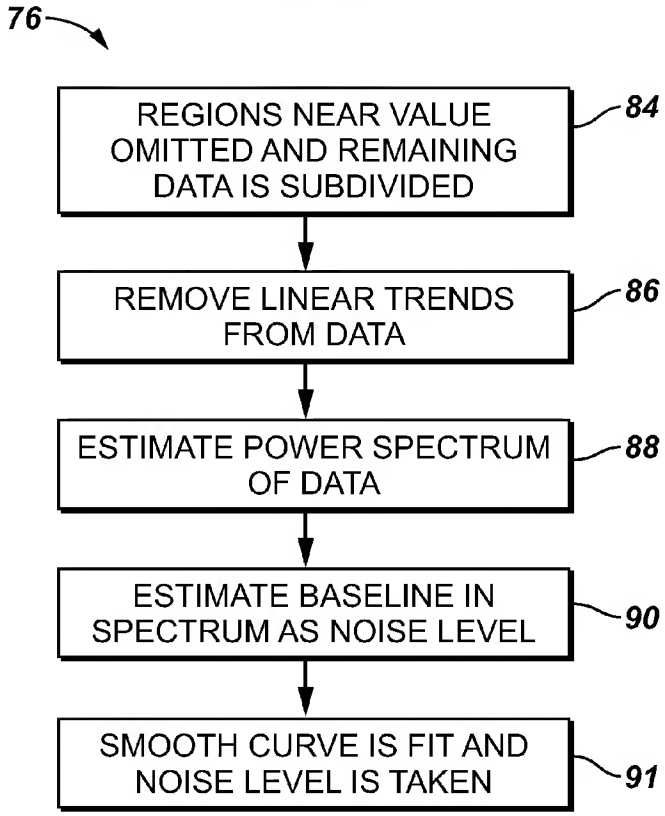
76
REGIONS NEAR VALUE OMITTED AND REMAINING DATA IS SUBDIVIDED
84
REMOVE LINEAR TRENDS FROM DATA
86
ESTIMATE POWER SPECTRUM OF DATA
88
ESTIMATE BASELINE IN SPECTRUM AS NOISE LEVEL
90
SMOOTH CURVE IS FIT AND NOISE LEVEL IS TAKEN
91

FIG. 9

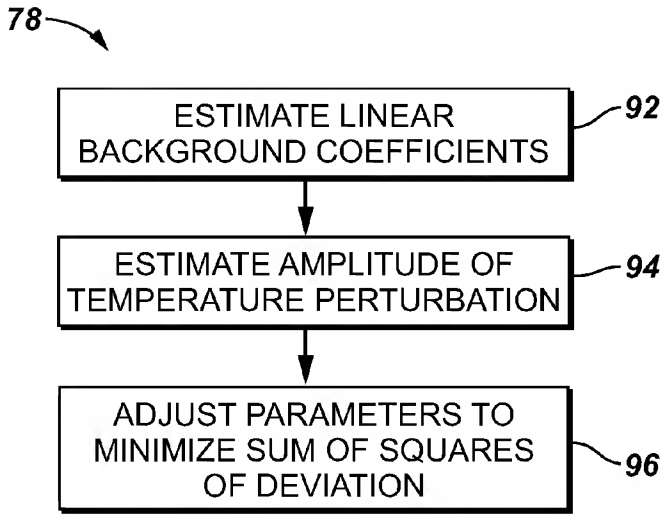
78
ESTIMATE LINEAR BACKGROUND COEFFICIENTS
92
ESTIMATE AMPLITUDE OF TEMPERATURE PERTURBATION
94
ADJUST PARAMETERS TO MINIMIZE SUM OF SQUARES OF DEVIATION
96

FIG. 10

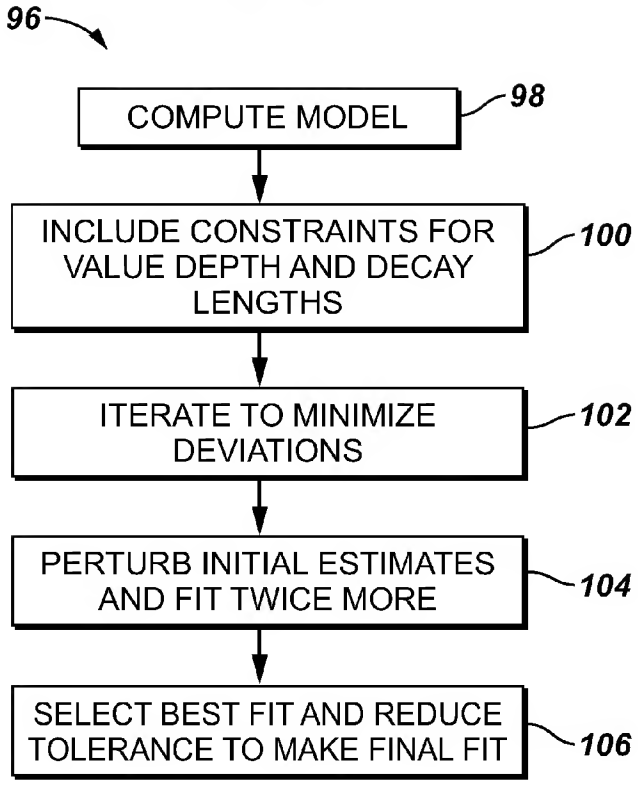
96
COMPUTE MODEL
98
INCLUDE CONSTRAINTS FOR VALUE DEPTH AND DECAY LENGTHS
100
ITERATE TO MINIMIZE DEVIATIONS
102
PERTURB INITIAL ESTIMATES AND FIT TWICE MORE
104
SELECT BEST FIT AND REDUCE TOLERANCE TO MAKE FINAL FIT
106

FIG. 11

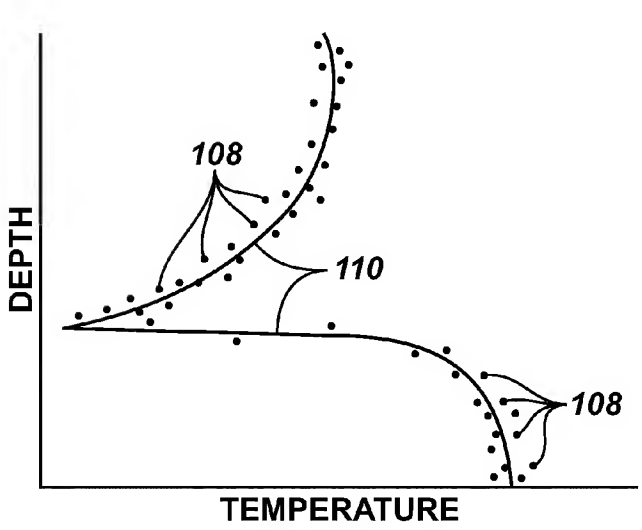
108
110
108
DEPTH
TEMPERATURE

FIG. 12

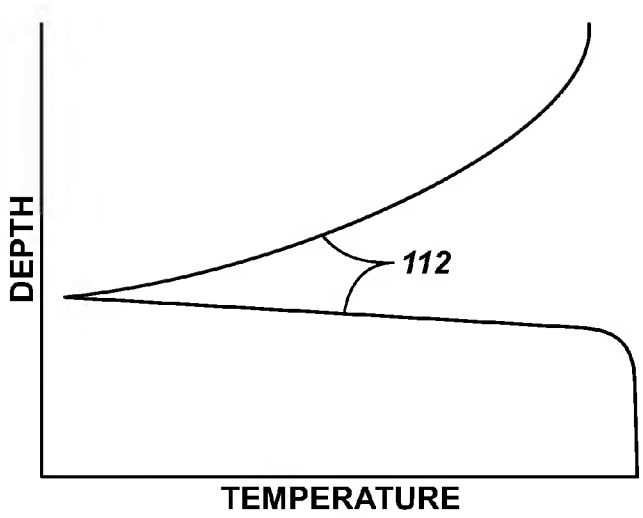
DEPTH
112
TEMPERATURE

FIG. 13

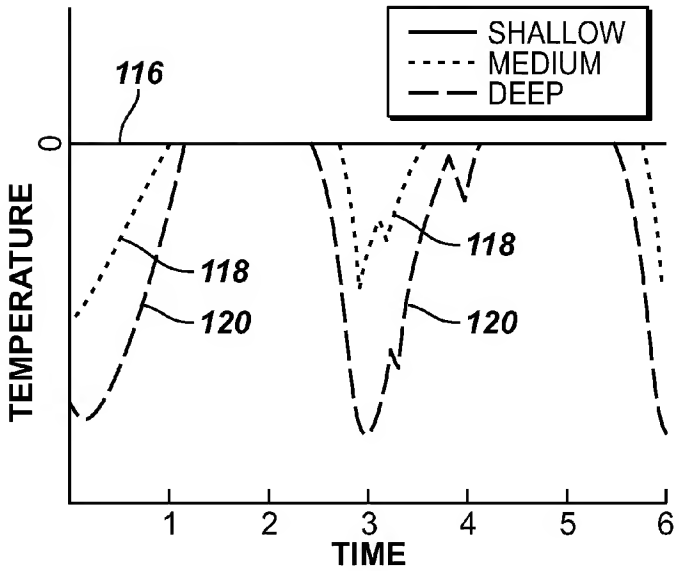
SHALLOW
MEDIUM
DEEP
116
0
TEMPERATURE
118
120
118
120
1
2
3
4
5
6
TIME

FIG. 14

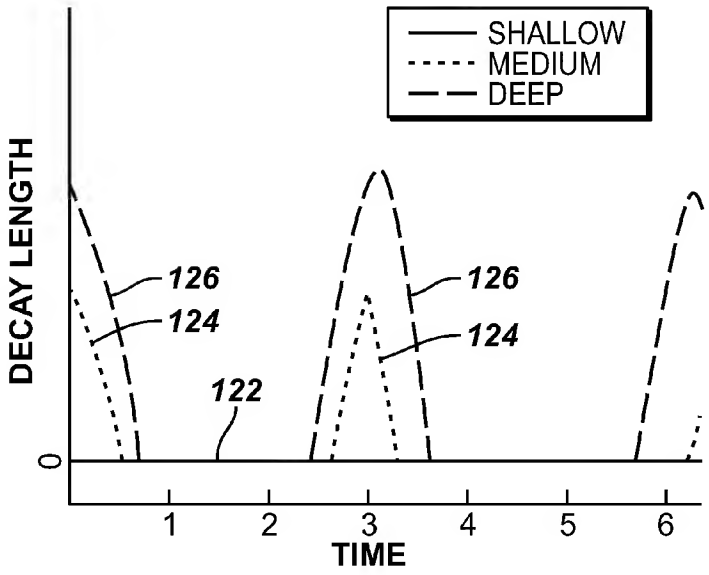
SHALLOW
MEDIUM
DEEP
DECAY LENGTH
126
124
122
126
124
0
1
2
3
4
5
6
TIME

FIG. 15

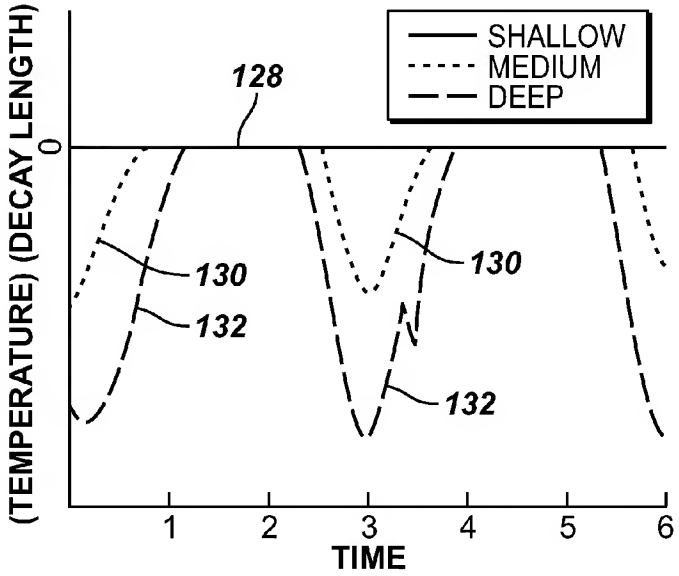
SHALLOW
MEDIUM
DEEP
(TEMPERATURE) (DECAY LENGTH)
128
0
130
132
130
132
1
2
3
4
5
6
TIME

FIG. 16

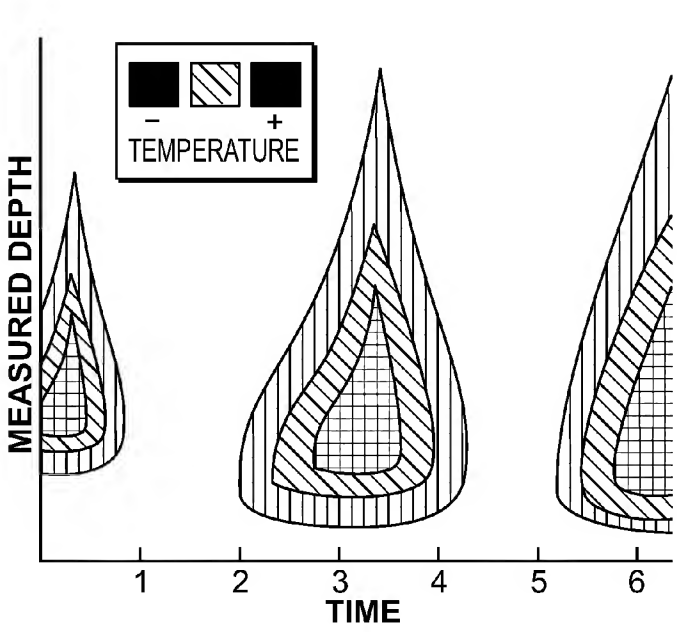

FIG. 18

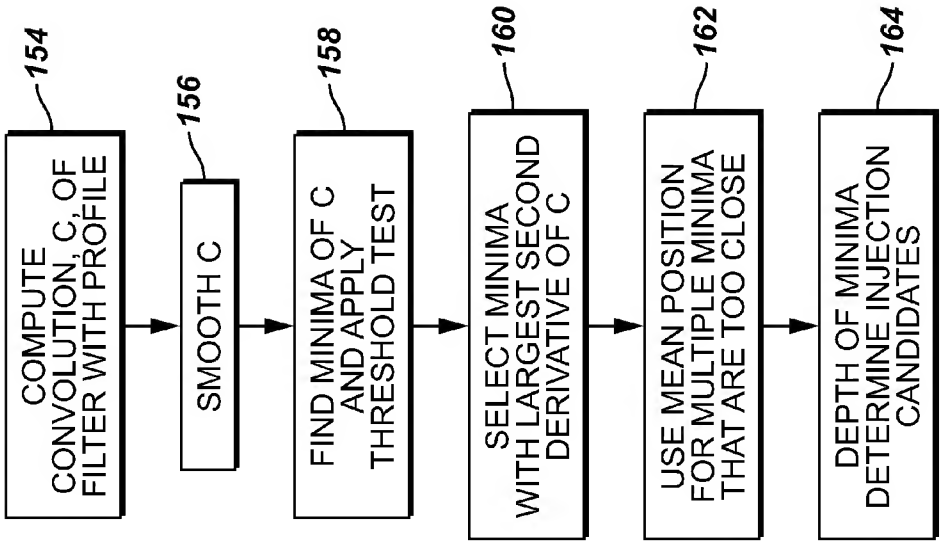
154
COMPUTE CONVOLUTION, C, OF FILTER WITH PROFILE
156
SMOOTH C
158
FIND MINIMA OF C AND APPLY THRESHOLD TEST
160
SELECT MINIMA WITH LARGEST SECOND DERIVATIVE OF C
162
USE MEAN POSITION FOR MULTIPLE MINIMA THAT ARE TOO CLOSE
164
DEPTH OF MINIMA DETERMINE INJECTION CANDIDATES

FIG. 17

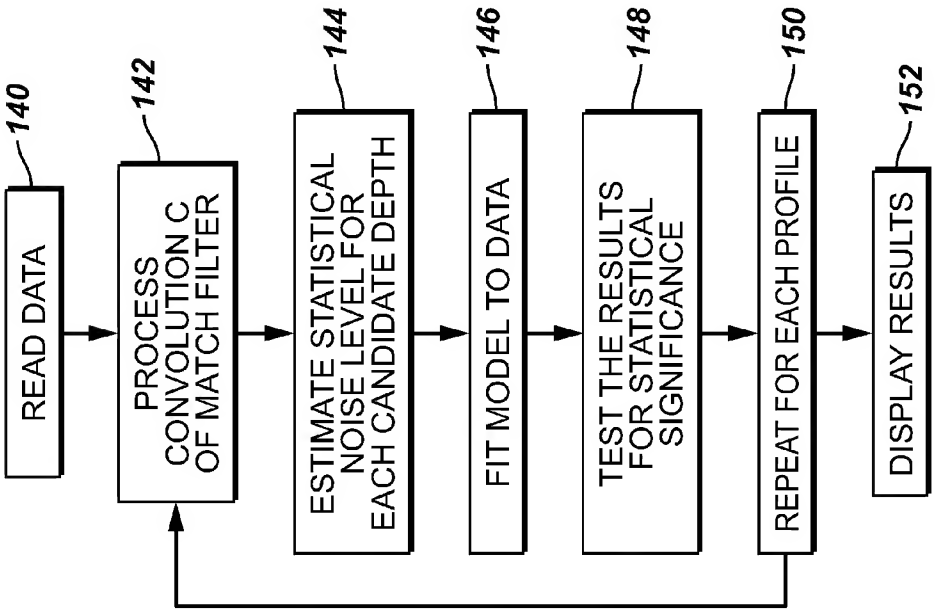
140
READ DATA
142
PROCESS CONVOLUTION C OF MATCH FILTER
144
ESTIMATE STATISTICAL NOISE LEVEL FOR EACH CANDIDATE DEPTH
146
FIT MODEL TO DATA
148
TEST THE RESULTS FOR STATISTICAL SIGNIFICANCE
150
REPEAT FOR EACH PROFILE
152
DISPLAY RESULTS

FIG. 19

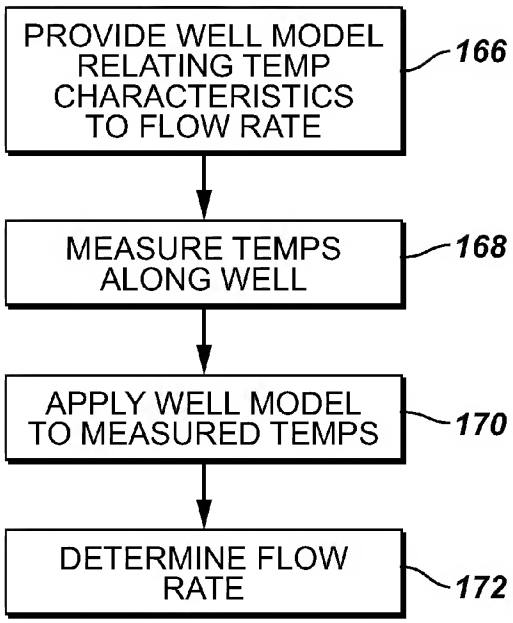

FIG. 20

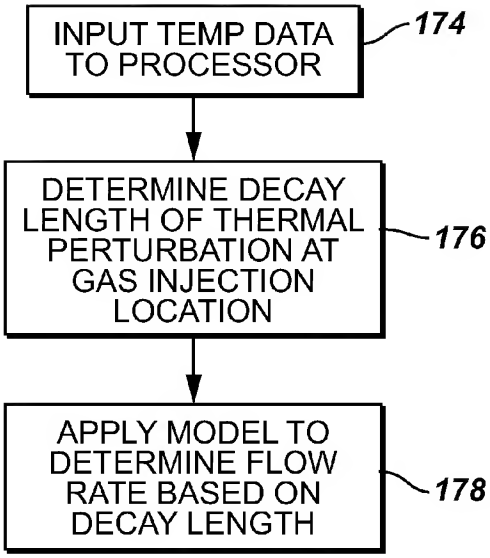

FIG. 21

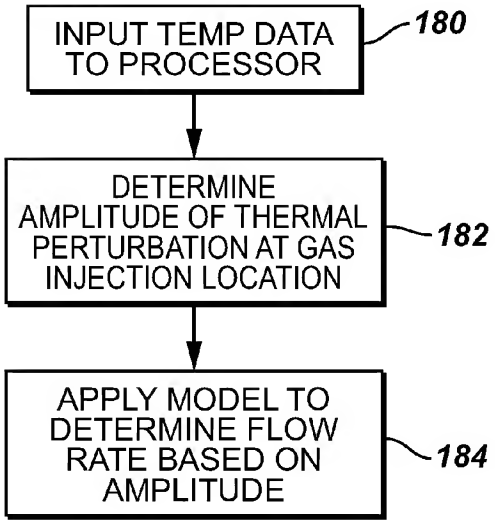
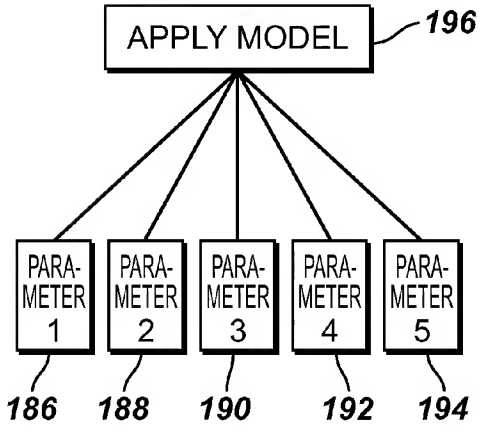
FIG. 22